

Quiz #3 (CSE4190.667)

May 11, 2015 (Monday)

Name: _____ Dept: _____ ID No: _____

1. (10 points) Given a knot sequence $0, 0, 1, 2, 3, 4, 4, 5, 5$ for a quadratic B-spline curve $\mathbf{x}(u) = \sum_{i=0}^7 \mathbf{d}_i N_i^2(u)$, $0 \leq u \leq 5$, with the control points:

$$\begin{aligned} \mathbf{d}_0 &= (-6, -1), \quad \mathbf{d}_1 = (-5, 2), \quad \mathbf{d}_2 = (-3, 3), \quad \mathbf{d}_3 = (-1, 2), \\ \mathbf{d}_4 &= (0, 0), \quad \mathbf{d}_5 = (3, 1), \quad \mathbf{d}_6 = (3, 3), \quad \mathbf{d}_7 = (1, 5), \end{aligned}$$

Compute $\mathbf{x}(1.25)$ and $\mathbf{x}'(1.25)$.

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2. (10 points) Given a tetrahedron, we apply the Doo-Sabin subdivision twice. How many faces, edges, and vertices are in the final refined mesh? How many faces are triangles and how many are rectangles?

3. (10 points) Given a rational cubic Bézier curve $\mathbf{x}(t)$, $0 \leq t \leq 1$, defined by four control points

$$\begin{bmatrix} 2 \\ 0 \\ 0 \end{bmatrix}, \quad \begin{bmatrix} 2 \\ 0 \\ 2 \end{bmatrix}, \quad \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \quad \begin{bmatrix} 2 \\ 0 \\ 4 \end{bmatrix},$$

and weights 1, 2, 2, 1. Using the de Casteljau algorithm, subdivide the rational curve at $t = 0.5$ into two pieces. What are the control points and their weights for the left and right half curves: $\mathbf{x}_l(u)$, $0 \leq u \leq 1$, and $\mathbf{x}_r(v)$, $0 \leq v \leq 1$.